California Division of Mines and Geology

Preliminary Fault Evaluation Report FER-77

April 18, 1979

1. Name of fault

Elsinore fault zone (north San Diego County segment).

2. Location of fault

Pechanga, Pala, Boucher Hill, and Palomar Observatory, California, 7.5 minute quadrangles, San Diego County (figure 1).

3. Reason for evaluation

Part of 10-year program.

4. List of references

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5. Summary of available data

Perhaps the earliest description of the Elsinore fault was by Fairbanks (1893). The first published map to show this fault, and report using the name "Elsinore" was by Lawson and others (1908, Map No. 1, and p. 19). Wood listed the historical earthquake (1769-1907) of California and suggested that a number of the events may have occurred along the Elsinore fault. Davis (1927) discusses the characteristics of the major "rifts" of southern California and refers to localities along the north end of the Elsinore fault as examples of various types of features. Most subsequent geologic mapping has been done on and near the zone of the Elsinore fault, in Riverside County. Mann (1955) mapped the fault in the Murrieta-Temecula region. Rene Engel (1959) worked in the Elsinore quadrangle (15 minute) from 1926 to 1934 and recognized and named most of the individual faults in the zone in that region. Gray (1961) described the north end of the zone in the vicinity of Corona. Weber (1977) did a detailed study at, and to the northwest of Lake Elsinore. Work by Kennedy (1977) extended from the south boundary of Weber's area (just northwest of Wildomar) southeast along the fault to the Riverside-San Diego County boundary. Work by the present writer (FER-76) was based in part on the work by Kennedy.

South of the Riverside-San Diego county boundary, the first published map subsequent to that of Lawson and others (1908), was by Larsen (1948). Larsen's map shows an inferred fault extending southeast from the county boundary to the valley of the San Luis Rey River just east of Pala Mountain (the Pauma Valley area on the Boucher Hill quadrangle, plate 3). This fault roughly approximates the position of the Elsinore fault, but it shows no displacement where it crosses lithologic boundaries. Larsen wrote (1948, p. 125):

> ---on the southeast flanks of the Agua Tibia Mountains, a few miles northeast of Pala, at the McGee Ranch, there is a narrow

> bench about two miles long at an elevation of about 1800 feet. The boundary of this bench with the mountains is fairly straight.---
>
> The mapping of the geology, including the mapping of the contact of the crystalline rocks with the beds of early Pleistocene age, does not indicate a fault. However, exposures in the critical area are poor, and the rocks are deeply weathered. In the canyon at the southeast end of the bench at McGee's Ranch, the rocks over a wide zone appear to be much brecciated as well as deeply weathered, and this may indicate the location of the fault zone.
>
> The major movement on the fault must have preceded the deposition of the beds of Pleistocene age, as they do not seem to be displaced.
>
> The fault on the southwest border of the Agua Tibia Mountains has commonly been considered to be a direct continuation of the Elsinore fault. It seems much more probable that the two faults are simply members of a fault system.

Larsen was aware of the width of the Elsinore fault zone in its more studied, Riverside County segment, so his supposition had basis in fact (FER-76). This is illustrated by later maps by R.H. Johns (1954a, maps 6 and 7, south of the Riverside-San Diego County boundary). Johns (1954a) produced two maps of segments of the Elsinore fault; one from Temecula to Pala (map 7) and one of the Warner Basin and adjacent areas (map 9), which left a gap on the southwest slope of Mount Palomar. These maps show truncated contacts with rocks of

Quaternary (Presumably Pleistocene) age and, in the Warner Basin, a contact between Mesozoic rock units shows apparent right-lateral seperation of some 6.8 miles (11 kilometers). They are good, clear maps but, being page illustrations, they are small scale and lack a topographic base. The entire Riverside-San Diego county line--Lake Henshaw segment of the Elsinore fault was shown on a map compiled by Jahns (1954b) but, at a scale of 1:380,160 ± it too is too generalized to portray stratigraphically meaningful events in the Quaternary. Jahns' work (1954a and b) was a source for subsequent similarly generalized, small scale compilations (Weber, 1963; Rodgers, 1965). However, in writing about the Peninsular Range province, Jahns (1954b) makes a number of interesting points. In describing major faults he states:

> ---Some segments of the major faults are concealed beneath very recent accumulations of alluvium and other debris; much of the trace of the Elsinore fault along the southwestern side of the Agua Tibia Mountains, for example, has been buried by large masses of slope wash and landslide material.

His apparent belief that the Earthquake Valley fault (1954b, p. 43) is active lends credence to the possibility that there is a southeastward trend in the seismic activity across the Agua Tibia Mountains (Jahns, 1954b, plate 3). In any event, the zone of faulting along the trend of the Elsinore fault appears to splay out into and, possibly around the Agua Tibia Mountains thus dispersing an already low potential for ground displacement. Microseismic activity increases in depth and intensity southward along this trend "In comparison to the San Jacinto fault to the east, the Elsinore fault shows a very little strike-slip displacement and is a seismically quiet area except for a localized area of east-west faulting in the far south near Vallecito Mountain." (Langenkamp and Combs, 1974).

Through some six miles south-southeastward from the Riverside-San Diego County boundary, the zone of the Elsinore fault lies in part within the Agua Tibia Primitive area. Irwin and others (1970) reported on the mineral resources of the primitive area. The pertinent part of their map is reproduced as figures 2 and 2a. Though this map yields no proof of Holocene activity, it illustrates the prominance of the fault as a geologic feature. Larsen (1948, p. 125) noted the brecciated state of rocks in exposures northeast of Pala, on the southwest flank of the Agua Tibia Mountains. Jahns and Wright, (1951, plate 1) and Irwin (1970) mapped a belt of breccia within the fault zone. If such material is typical of the main trace of the Elsinore fault zone in this region it might be one reason for subdued or eroded evidence of the most recent surface breaks. The presence of abundant landslide and debris-flow deposits, alluded to by Jahns (1954a,b), along the steep southwest flank of the Agua Tibia Mountains suggests considerable if not pervasive shearing and/or brecciation of the rocks underlying that slope.

6. Interpretation of air photos

Many of the features on the accompanying maps (plates 1 through 4) were derived from U.S. Geological Survey Water Resources Development photos (1967), United States Department of Agriculture photos (1953), and much earlier Fairchild air photos. The photos assisted in locating many features not shown on published maps but also confirmed and in some places led to the modification of some of the published fault traces. So, symbols (VC, T, etc.) applied to photo-derived features are, in some instances applied to published features (plates 1 through 4).

7. Field observations

From the Riverside-San Diego County boundary to Pauma Valley (plates 1 and 2) the tract of the Elsinore fault crosses the northwest flank of the Agua Tibia Mountains from Temecula Creek, in the Elsinore trough to the vicinity of

Trujillo Creek, north of Pala, there is an increase of some 1000 feet (305m) in elevation. With this change, comes an increase in annual rainfall and steeper stream gradients. In addition, many water courses that have disected the fault zone drain slopes or have tributaries that drain slopes of ridges and peaks with elevations that exceed 5000 feet (1525m) just three to four miles (5 to 7km) to the southeast of the fault trace. It follows that evidence of Holocene faulting is less pristine here than in the Elsinore trough.

In spite of wet weather, bad roads, and locked gates, a number of useful exposures were located on or near to linear features and fault traces noted on photos or acquired from published material. Plates 1 through 4 display the accumulated data.

The following descriptions of exposures are flaged on plates 1 through 4 by number.

1. A road cut (road not shown on the 1968 edition of the Pala quadrangle) on the south-facing flank of a ridge in the NW corner of Sec. 29, T. 9 S., R. 1 W. An iron-stained terrace deposit appears to be warped upward and tilted eastward near an apparent fault contact with a zone of fractured and crushed igneous rock approximately 100 feet (31m) wide (plate 2). This lies near a previously located lineation.

2. A cut on the road to Mount Palomar, just south of the La Jolla Indian Reservation boundary. Weathered bouldery alluvium faulted down on the south-southwest (down slope) side of what appears to be a high-angle, reverse fault dipping 80 to 90 degrees north-northeast. This locality is in Sec. 21 (projected), T. 10 S., R. 1 E., Boucher Hill quadrangle (1948; revised 1971) (plate 3). It lies on a previously located

lineation. Most recent displacement could have been Holocene but the weathered character of the alluvium leaves the possibility of an older date open.

3. A fault exposed in the north wall of a canyon (an easterly tributary of Pauma Creek) entered by an unimproved road from the foot of Nate Harrison Grade, about one quarter mile east of BM 1564 and around the first major bend in the canyon as shown on Boucher Hill quadrangle (1948; revised 1971, see plate 3). The fault zone appears well defined. However, a thin bed or seam in the rocks is exposed on both sides of the fault and shows little offset. So, this fault may indicate mainly horizontal displacement assuming that the separated beds are one and the same. This fault is not on but only near a trace located by photos so it may be a minor fault. It is concealed in part by a prism of terrace gravel on the canyon wall. The gravel did not appear to be cut by the fault but fault features would not be likely to be well expressed or long preserved in such material.

8. Seismicity

Local residents of the vally of the San Luis Rey River recall a number of small disturbances assumed to be earthquakes. Perhaps some of these originated in neighboring regions. During the years 1900 through 1974, there were no earthquakes of magnitude 4 or greater on the segment of the Elsinore fault discussed in this report (Real and others, 1978).

9. Conclusions

The trace of the Elsinore fault is marked by well-defined features southeastward from the Riverside-San Diego County boundary as far as Pauma Valley shown in green on (plate 2). Although the evidence is less pristine than that found in the Elsinore trough in Riverside County, here, as there, the most recent trace stands in contrast to the many other features of probable or possible fault origin arrayed along the zone of the Elsinore fault. From the northwest end of Pauma Valley (plate 2) southeasterly to the boundary between the Palomar Observatory (plate 4) and Mesa Grande quadrangles, a clear choice of features became too uncertain to make. Indeed, at Pauma Valley (plate 3), a strongly scarp-like feature along the course of the San Luis Rey River suggests that the fault zone may be as much as two and one third miles wide (about 4km) in that vicinity. However, it was not determined whether or not the apparent scarp along the river at Pauma Valley is natural or artificial. If it is not a scarp, the main trace and probable site of most recent displacement is most apt to be found among the apparent fault traces in the Tin Can Flat area to the northeast (plate 3) on Nate Harrison Grade.

10. Recommendations

I recommend that the Elsinore fault be zoned along its best defined trace as delineated in green on plates 1 and 2 attached. This zone, a southeastward continuation of that recommended in FER-~~77~~76, extends from the Riverside-San Diego County boundary, southeastward to a road 0.6 miles southeast of Adams Drive at the northwest end of Pauma Valley. The linear feature along the course of the San Luis Rey River at Pauma Valley (plate 2) should be given more study. It was found on photos after the opportunity to field check it had passed.

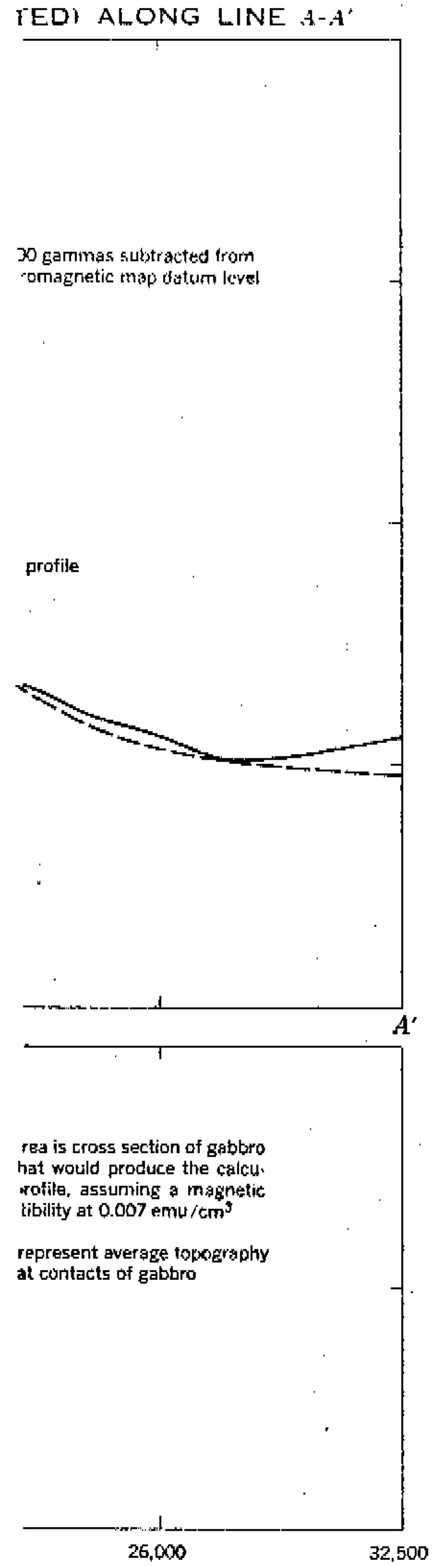
11. Investigation by:

Richard B. Saul

RICHARD B. SAUL
April 18, 1979

I agree that Elsinore flt (main trace) should be zoned (Pechanga; Pala q-ds). However, some adjustment should be made on locations of traces (see my notes on Pl 1 & 2). no time available for further work.

EWH
4/27/79



EXPLANATION

Stream sands and gravels, and low-level terrace deposits

Alluvial fan and high-level terrace deposits

Temecula Arkose of Mann (1955)

QUATERNARY

Granodiorite

Tonalite

Gabbro

Metamorphic rocks

CRETACEOUS OR OLDER

Contact
Dashed where approximately located; dotted where concealed

Fault
Dashed where approximately located; dotted where concealed

45
Strike and dip of beds

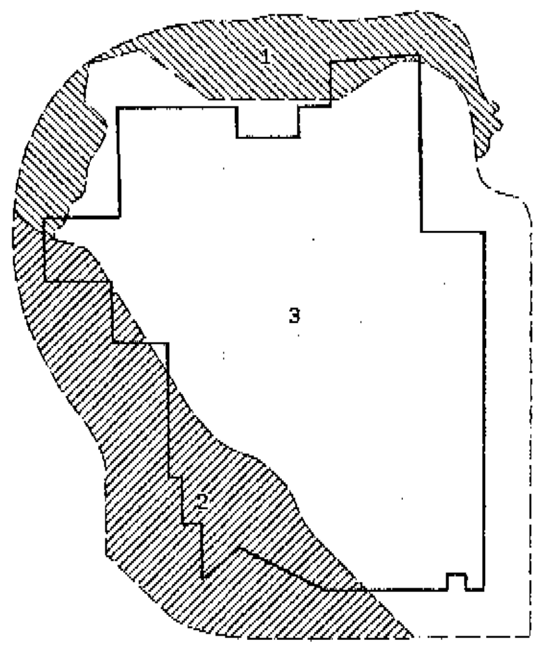
25
Inclined Vertical Horizontal
Strike and dip of foliation

75
Inclined Vertical
Strike and dip of joint

Breccia zone along Elsinore fault

Boundary of Agua Tibia Primitive Area

Magnetic contours
Contour interval is 20 and 100 gammas on a magnetic datum of 50,400 gammas (at zero contour the total intensity of the earth's magnetic field is 50,400 gammas). Flown at 6000 foot altitude (barometric). Flight lines are north-south with approximately 1-mile spacing and are shown by dashed lines. Position of magnetic profile is shown by line A-A'



INDEX TO GEOLOGICAL MAPPING

1. Modified from Mann (1955)
2. Modified from J. B. Hanley and others (unpublished data)
3. Reconnaissance by W. P. Irwin and R. C. Greene, 1969

[M]AGNETIC MAP WITH AN AEROMAGNETIC PROFILE